

skilled in the art. A procedure, computer executed step, logic block, process, etc., is here, and generally, conceived to be a self-consistent sequence of steps or instructions leading to a desired result. The steps are those requiring physical manipulations of physical quantities. Usually, though not necessarily, these quantities take the form of electrical or magnetic signals capable of being stored, transferred, combined, compared, and otherwise manipulated in a computer system. It has proven convenient at times, principally for reasons of common usage, to refer to these signals as bits, values, elements, symbols, characters, terms, numbers, or the like.

[0054] It should be borne in mind, however, that all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities. Unless specifically stated otherwise as apparent from the following discussions, it is appreciated that throughout the present invention, discussions utilizing terms such as “projecting” or “detecting” or “changing” or “illuminating” or “correcting” or “eliminating” or the like, refer to the action and processes of an electronic system (e.g., interactive video system **100** of FIG. 1), or similar electronic computing device, that manipulates and transforms data represented as physical (electronic) quantities within the electronic device’s registers and memories into other data similarly represented as physical quantities within the electronic device memories or registers or other such information storage, transmission or display devices.

[0055] Various embodiments of the present invention, a self-contained interactive video display system, are described herein. In one embodiment, a flat-panel display screen displays a visual image for presentation to a user on a front side of the flat-panel display screen. A first illuminator illuminates the flat-panel display screen with visible light. A second illuminator illuminates an object. A camera detects interaction of an illuminated object with the visual image, wherein the camera is operable to view the object through the flat-panel display screen. A computer system directs the projector to change the visual image in response to the interaction.

[0056] Interactive Video Projection System

[0057] The present invention in the form of one or more exemplary embodiments will now be described. According to one exemplary embodiment, an interactive video system **100** as shown in FIG. 1 is provided. The interactive video system **100** uses a camera **115** fitted with a filter that blocks visible light, an illuminator **125** that illuminates screen **130** being viewed by camera **115**, a projector **120** that projects an image onto the interactive space of screen **130**, and a computer **110** that takes as input the image of camera **115** and outputs a video image to projector **120**. In one embodiment, illuminator **125** is an infrared illuminator and camera **115** is an infrared camera operable to record images illuminated by the infrared light of illuminator **125**. It should be appreciated that camera **115** and illuminator **125** can be configured to operate using any form of light that is not visible, and is not limited to infrared light.

[0058] Computer **110** processes the camera **115** input to discern on a pixel-by-pixel basis what portions of the volume in front of screen **130** are occupied by people (or moving objects) and what portions of screen **130** are back-

ground. Computer **110** accomplishes this by developing several evolving models of what the background is supposed to look like, and then comparing its concepts of the background to what camera **115** is currently seeing. Alternatively, components of computer **110** that process camera **115** input are collectively known as the vision system. Various embodiments of this vision system are described in co-pending U.S. patent application Ser. No. 10/160,217, filed on May 28, 2002, entitled “INTERACTIVE VIDEO DISPLAY SYSTEM,” by Bell, and assigned to the assignee of the present application, in co-pending U.S. Provisional Patent Application No. 60/504,375, filed on Sep. 18, 2003, entitled “SELF-CONTAINED INTERACTIVE DISPLAY SYSTEM,” by Bell, and assigned to the assignee of the present application, and in co-pending U.S. Provisional Patent Application No. 60/514,024, filed on Oct. 24, 2003, entitled “METHOD AND SYSTEM FOR PROCESSING CAPTURED IMAGE INFORMATION IN AN INTERACTIVE VIDEO SYSTEM,” by Bell, and assigned to the assignee of the present application, all of which are herein incorporated by reference.

[0059] The evolving background is an important part of the vision, as it allows the system to be resilient to changes in lighting, scuff marks on the screen, and other disturbances. The output of the vision system is a black and white mask image that feeds into an effects engine, which also runs on computer **110**. The effects engine runs the applications that create the interactive graphics on screen **130**. Artists can design effects using a large variety of effect components as well as scripting, allowing them to create a wide variety of interactive experiences. Finally, the images created by the effects engine are outputted to projector **120**.

[0060] It is desirable that all the electronic components of interactive video system **100** (e.g., camera **115**, projector **120**, computer **110**, and illuminator **125**) are on one side of screen **130** while the user interaction takes place on the other side of screen **130**. In one embodiment, screen **130** is partially translucent for the light of projector **120** to allow an image to form on the surface of screen **130**. However, screen **130** is also partially transparent to camera **115** so that camera **115** can see objects on the opposite side of screen **130**. It should be appreciated that the terms transparent and translucent as referred to throughout the current specification are defined as meaning at least partially transparent and/or translucent, respectively. It should also be appreciated that the terms “scattered” and “not scattered” as referred to throughout the current specification are defined as meaning “substantially scattered” and “not substantially scattered” respectively. Finally, it should also be appreciated that the terms “diffused” and “not diffused” as referred to throughout the current specification are defined as meaning “substantially diffused” and “not substantially diffused” respectively.

[0061] FIG. 1 shows one physical configuration of the components of an exemplary embodiment of the present invention. All sensing and display components, including camera **115**, illuminator **125**, computer **110**, and projector **120**, are inside a box **140**. In one embodiment, all sides of the box **140** are opaque except for one side. This one side which is not opaque is a screen **130** for displaying the projected image.

[0062] In one embodiment, smooth, flat materials that have strong Rayleigh scattering and relatively little scatter-